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Deep Diving into Service Design Problems: Visualizing the Iceberg Model of Design Problems through a Literature Review on the Relation and Role of Service Design with Wicked Problems

Abstract:

This article examines and discusses the connection and the role of service design in the wicked problem field. Many management theorists divide problems into three categories, simple, complex and wicked. The latter is the most difficult and requires specific methods and tools. Systematic literature review was performed to see what the relation and role of service design are in wicked problems. A summarised list of the findings was made to uncover it. In conclusion, the paper presents an "Iceberg Model of Design Problems" so that service designers can use proper tools designed for each category and so as not to treat wicked problems too simplistically.

Keywords: service design, wicked problems, "Iceberg Model of Design Problems"

Wicked Problems in Service Design - Introduction

This article uses theoretical framework and partly systematic literature review to discuss about the connection and the role of service design in wicked problems. The overall aim is to build a theoretical framework to discuss the service design problems and to clarify what kind of typologies of problems designers, especially service designers, deal with in their professional practice. The relevance of this study is that particularly the wicked problems would not be over simplified and that there would be tools designed for each category or typology of problems.

We could thus better avoid making spin-off problems and tame wicked problems more efficiently.

Buchanan (1992) wrote that some design problems have wicked connotations and that design has evolved to 'resolve' modern-day wicked problems. In the same article, he introduced the concept of four orders (or areas) of design problems: 1) 'symbolic and visual communications' (graphic design), 2) 'material objects' (industrial or product design) 3) 'the design of activities and organised services' (service design) and 4) 'the design of complex systems or environments for living, working, playing, and learning' (p. 9-10). Service design is aligned to the third Buchanan's order of design problems (problems of action). As an emerging field (Mager, 2010), service design aims to create optimal service experiences. Stickdorn and Schneider (2011) defined five principles that service design is built upon: (a) user-centeredness, which can mean to design with a community or different participants and meeting their needs as the main focus of the project; (b) co-creativity as it seeks to involve all relevant stakeholders; (c) sequencing by splitting complexities into manageable parts; (d) evidencing by visualizing often service experiences, thus making them tangible; and (e) holistic, a way of studying things as a whole and not treated as parts.

As argued by Manzini (2011), service design issues are complex, and often "un-designable"; thus, he calls attention to the need of developing its culture and practice. In the same sense, Sangiorgi (2009) presented the need for more research in service design in the field of complexities, including wicked problems. Simple (i.e., tame), complex and wicked problems are the general categories of design problems. Nonetheless, it is uncommon to bring up a discussion about wicked problems in the field of service design even though it focuses on designing services to treat social issues (Miettinen and Valtonen 2012; Wetter-Edman 2014), and, according to theorists, wicked problems are social (Rittel and Webber 1973) or called social messes (Horn and Weber 2007).

Therefore, the article begins by explaining why we use the term wicked problems in the first place. Sometimes, designers seem to confuse wicked, complex, and simple problems. It is common to read articles whereby some designers or service designers claim that all design problems are wicked (e.g. Ameli 2017). Only the two last of Buchanan's (1992) four areas of design treat the wicked problems in greater depth, but not solely. The first and second design orders are not really wicked: making a pamphlet is a simple problem compared to trying to tame poverty. As Westerlund and Wetter-Edman (2017) wrote: "Designers whose mind-set and approach works well considering the impact in Buchanan's first and second orders, may not have the tools, mind-set or approach to create understandings of the impacts in the third and fourth orders of design." (p. 17). Also, one can read citations to how one 'solved' a wicked problem (Country Brand Report, 2010). In Rittel and Webber's (1973) theory, however, solutions to wicked problems are not possible because if there were a solution, they would not be wicked problems to begin with. In the design literature, there are references to wicked problems at times without actually telling what they are and thus do not clarify if they really treat wicked problems.

Borrowing the framework of micro, meso and macro-level that social workers use to understand the world (DeCarlo 2018), we argue that, more often than not, wicked problems are societal challenges as are the macro-level issues. Thus, they have an impact on many meso- and micro-level issues but cannot be solved by dealing only with these categories. In the social worker field, micro-level issues deal with individual and one-on-one interactions, while meso-level ones consider group interactions, and macro-level, institutions and policies (DeCarlo 2018) affecting from entire communities to even a country. Micro-level issues can be in the service design field, for example, a service for supplying Nespresso capsules, whereas meso-level issues could regard designing a bike-sharing service for different groups of users. Macro-level issues would be, for example, designing services for a new healthcare national system. Micro-

level issues are more solvable, but wicked problems are not. Therefore, the very first contribution of this paper is the analogy within Buchanan's four orders of design, the framework from social work (micro, meso and macro-levels) and the wicked problem theory. Having an in-depth understanding of that theory will contribute to the way we handle practice.

The second part of this article includes a systematic literature review as a research method that seeks to answer two research questions: RQ1: What is the connection between service design and wicked problems? RQ2: What is the role of service design in tackling wicked problems?

Conklin (2006) and Camillus (2008) argue that using simple tools for wicked problems may be a painful process. This article has an assumption that by understanding the theoretical background of service design and wicked problems together with the three levels of the design problems will help designers to decide which methods and tools are applicable as well as to better manage skills, stakeholders and the project schedule. It will also clarify what capabilities service designers need to have when dealing with wicked problems. As Webster and Watson (2002) pointed out, a good literature review creates new or enhances current theories. As the main contribution from the literature review, we present an "Iceberg Model of Design Problems" on how to use its typology to adequately address each category of problems: simple (tame), complex, and wicked.

The Wicked Problem Theory

This chapter, together with the following chapter of the "Typology of Problems", aims to situate the study in the current theory of the research topic. Initially, the wicked problem terminology was coined by Rittel and Webber (1973), who described ten characteristics when a problem becomes wicked. When one tries to resolve a wicked problem, the "solutions"[1] can be classified as good or bad but not as right or wrong. Also, each attempt to tame a wicked problem

is a one-time operation. A pilot or the intended solution might change the first scenario; a new problem definition is hence required again. It is hard to make wicked problem definitions as they are multidimensional and involve multi-stakeholder management (Roberts 2000). Since those that define the problem will also determine its resolution[1], the right stakeholders must be included so a less negative impact derives from the solution. Poorly managed wicked problems generate new ones called spin-off wicked problems. Indeed, as Rittel and Webber (1973) point out, one wicked problem is a symptom of another.

Wicked problems are all essentially unique (Rittel and Webber 1973). Also, the solution can always be improved. Still, Rittel and Webber (1973) think that wicked problems cannot have exhaustively descriptive solutions. It is hard and sometimes even dangerous to be a wicked problem solver as there are consequences if the solution is not desirable. Wicked problems do not have a stopping rule (Rittel and Webber 1973). Further in the text, we discuss how wicked problems and service design connect to each other.

Typology of Problems

To deeply understand the differences between wicked and other kinds of problems, we take the perspective of problem typology from the management field (Roberts 2000; Head and Alford 2008). Roberts (2000) divides problems into three categories. Type 1 includes simple problems, while Type 2 problems are complex, and Type 3 problems are wicked. In Type 1, the stakeholders reach a consensus as to what the problem is, whereas, in complex problems, stakeholder conflicts exist. In wicked problems, the levels of stakeholder conflict are even

[1] *It is hard to precisely write about wicked problems as a solution, because there are no solutions. This text uses the word "solutions", but still knowing that there is no solution.*

higher as pointed out by Roberts (2000, 1): "In this instance, there is no agreement on the problem or its solution"

Head and Alford (2008) refer to the theories of Heifetz (1994) when describing problems as Types 1, 2, and 3. Head and Alford (2008) translated the theory proposed by Heifetz (1994) into a typology, illustrated in Table 1. The typology of three levels remains, but these authors also divide the problem scope into complexity and diversity (i.e., diversity of opinions of the stakeholders and participants, and complexity in the way in which the problem is understood).

Table 1 Typology of Problems

Diversity → **Complexity ↓**	**1. Single party as all share the same opinion or goal** (Head and Alford 2008)	**2. Multiple parties, each having only some of the relevant knowledge** (Head and Alford 2008)	**3. Multiple parties, conflict in values/ interests** (Head and Alford 2008)
A. Both problem and solution are known (Heifetz, 1994)	**1** **Very tame problem** (Head and Alford 2008; Roberts 2000)	**2** **Tame problem** (Head and Alford 2008; Roberts 2000)	**3** **Complex problem** (Head and Alford 2008; Roberts 2000)
B. Problem is known, but solution isn't or other way around known (Heifetz, 1994)	**2** **Tame problem** (Head and Alford 2008; Roberts 2000)	**3** **Complex problem** (Head and Alford 2008; Roberts 2000)	**4** **Wicked problem** (Head and Alford 2008; Roberts 2000)
C. Neither problem nor solution are known (Heifetz, 1994)	**3** **Complex problem** (Head and Alford 2008; Roberts 2000)	**4** **Wicked problem** (Head and Alford 2008; Roberts 2000)	**5** **Very wicked problem** (Head and Alford 2008; Roberts 2000)

Note. Adapted from Head and Alford (2008, 7) and Suoheimo (2016, 100; 2019, 3).

Although the problems could be categorised into nine levels, using three would make the theory more practical and straightforward (Suoheimo 2016; 2019). However, two categories—simple and complex—would be too narrow since the tools, methods or approaches differ in each category. We agree that using the three categories, simple, complex and wicked (Heifetz 1994; Roberts 2000; Head and Alford 2008), would help us to create better strategies for social issues.

Suoheimo (2016, 2019) opens the three categories a bit more using numbers from 1 to 5 adding "very simple problems" and "very wicked problems". Very simple problems (1) could be to make a ball, simple problems (2) handling issues, such as designing a table, while complex problems (3), such as car ergonomics, wicked problems (4) could be issues, such as mobility planning, and very wicked problem (5), to curb global warming.

Before the wicked problem theory, Simon (1969) had already written about the need to use participatory ways in planning in complex settings that are similar to wicked problems. He was the first author to classify design problems as ill-defined (or ill-structured) and well-defined (well-structured). One more author that backs up the categorization of problems into three levels is Keith Grint, from the management field, by using the nomenclatures critical, complex and wicked. According to him, critical problems require immediate and often authoritarian strategies, whereas wicked problems are more complex and for which collaborative strategies work better (Grint 2010).

Research Method: Systematic Literature Review of Wicked Problems in Service Design

This systematic literature review aims to identify the literature that connects wicked problems with service design. Service design is a field that often works with social issues, which are frequently also sensitive and wicked (Miettinen and Kuure 2013). Nonetheless, this approach is not always found in the mainstream literature of service design. Defining (design) problems as complex is more common since this concept is not as specialised as that of wicked problems. Sangiorgi (2009) writes of a need to focus on three areas in service design for future research: interactions, complexity, and transformation. In her paper, she briefly refers to wicked problems.

We used the Web of Knowledge search engine to survey the literature that relates service design to wicked problems. In the first attempt, with the words “wicked problem” AND “service design”, considering both in all the fields of search, returned no results. The second attempt, “wicked problems” and “service” was used, since service design is a relatively new discipline and most of its background comes from management and marketing studies as well as from computer science and information systems. It returned 23 results if no period of time was defined, and 19 results when we limited the search to the period 2013-2018. Considering the search without a time limit, most of the papers regard environmental sciences and studies (8), public administration and public environmental occupational health (5), besides business and management (4). We took this snapshot to have a general view, although we wished to see how this worked in relation to the service design field by investigating the design discipline.

The search in design journals yielded better results when performed directly in them because some scientific research engines did not have the latest issues found in the journals web page. Also, some relevant design journals are not listed in research engines (e.g., Scopus does not list Design Philosophy Papers). A research protocol was created as it makes a systematic literature review “rigorous, replicable, and extensive” (Peters et al. 2015, p. 142). A total of 10 design journals with different publishing focuses were selected, as shown in Table 2. The criteria to select these journals was their evaluation at the Scimago Journal & Country Ranking and the Academic Finnish Publication Forum (JUFO).

Table 2 Results of the Systematic Literature Review

Journal October 2018	**Scimago (Arts and Humanities) 2018-19**	**JUFO 2018 -19**	**Number of articles**	**Number of excluded articles**	**Number of articles in total**
THE DESIGN JOURNAL	Q2	2	27	12	15
DESIGN AND CULTURE	Q1 / Q2	1	7	3	4

SHE JI	-	1	6	3	3
INTERNATIONAL JOURNAL OF DESIGN	Q2	2	4	4	0
DESIGN STUDIES	Q1	2	3	2	1
DESIGN PHILOSOPHY PAPERS	-	1	3	0	3
DESIGN MANAGEMENT JOURNAL	-	0	3	0	3
DESIGN MANAGEMENT REVIEW	-	1	2	2	0
STRATEGIC DESIGN RESEARCH JOURNAL	-	1	0	0	0
DESIGN ISSUES	Q2	3	0	0	0
TOTAL 10			55	25	29

Note: Scimago ranks the highest-quality journals as Q1 and the lowest as Q3. JUFO uses rank 3 for highest-quality journals and 0 for the lowest.

The terms ‘service design’ and ‘wicked problem’ (both entered with quotation marks) were also very limited when the search was performed directly in the journals and were abandoned for this reason. It could be that some authors refer to wicked issues in other terms and not just as problems. The timeline of the articles was the period from 2013 to 2018, and all the research was performed by the end of 2018. We used this timeline to see what the state-of-the-art research in the field was. Also, there were not many more hits if searched before 2013 (Fig. 1), probably because the service design literature had an expressive growth only after 2010. Interestingly, the literature on wicked problems had also started to grow only after 2007.

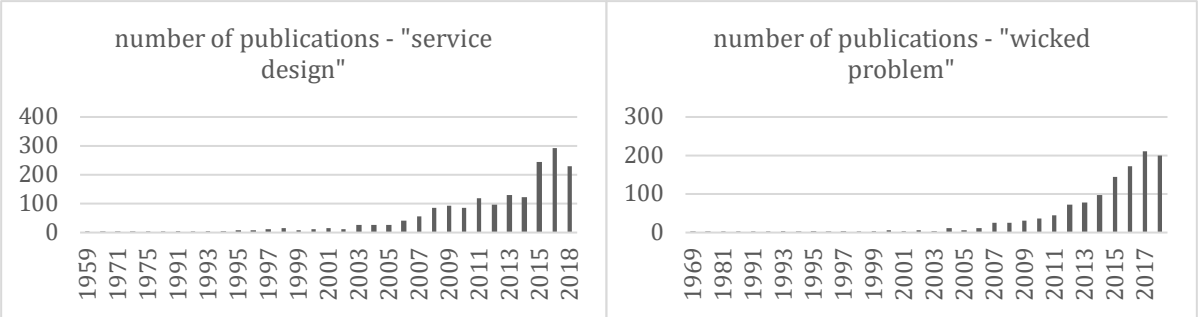

Figure 1 Number of publications with the words "service design" and "wicked problem" since it first appeared in the literature (1959 for service design, and 1969 for wicked problem) using the Web of Knowledge.

We soon noticed that the search engine tagged many articles because the words 'wicked problem' were in the references but not in the text and were therefore excluded. Papers were then analysed systematically. In the first round of analysis, we sought information on how relevant the articles were regarding wicked problems and the service design field. We had texts copied and pasted onto the Excel spreadsheet to find out how the article defined the designers, especially, if possible, the service designer's role and connection in wicked problems. We ranked the articles as of low, medium, and high relevance. The protocol defines the selection criteria in more depth, but basically these articles had some problems in defining the wicked problem in the sense Rittel and Webber (1987) do it or, similarly, they were not able to properly tell or connect with service design. An important fact is that the problem in question should be social once wicked problems are social (Rittel and Webber 1987; Horn and Weber 2007). Following this sorting, only 29 articles were selected as relevant for review.

In the second cycle of the literature review, two more columns were added that would further treat what the wicked problem was and how service design was raised in the text separately. Direct text quotations were made besides interpretation of the text in the columns. After this, the text was coded. Most often codes consist of words or short sentences as one way of

analysing qualitative data (Saldaña 2013). "Coding is not a precise science; it is primarily an interpretive act. Also, one should be aware that a code can sometimes summarize, distil, or condense data, not simply reduce them" (Saldaña 2013, p. 4). Note that when making qualitative coding, each researcher may interpret the material differently or raise issues that each find relevant (Saldaña 2013). The way of making the coding or systematic literature review protocol was discussed among the participants in peer-review style meetings.

In the last cycle, we grouped the codes that had points in common. One example could be that urban planning or transportation planning were mentioned as wicked problems. Both were grouped under the urban planning term. Words that had only one hit were not included in the results, since they were mentioned in only one article and did not gain more support from others.

Results

The limited number of articles left for review could also imply the need for writing and producing more knowledge on the topics of service design, wicked problems, and their connections. When analysed by using keywords, there were often repeated ones (e.g., social design; innovation; systems; sustainable design; collaboration; co-design; strategic design; complex problem or change). All these words are as much related to wicked problems as to service design. None of the articles had the keywords "service design" and "wicked problems" together. This could also imply that there is a research gap of the literature in the field that would make a more conscious connection of both terms right from the beginning. We needed to read all the articles through to be sure they treated both issues.

Figure 2 shows the results from the third cycle, the themes of wicked problems the articles treated or mentioned as examples. Social challenges come as number one with change. Interestingly, the word environment comes only as fifth in order since it was the first in the

search made in the Web of Science. Another important wicked issue was sustainability, which could be related to the environment, too. Actually, grouping environment and climate change under sustainability, it would gain the biggest scores. Also, politics, systems, public services, climate change and urban planning were surveyed. Culture, organizational change and uncertainty each had a smaller number of hits.

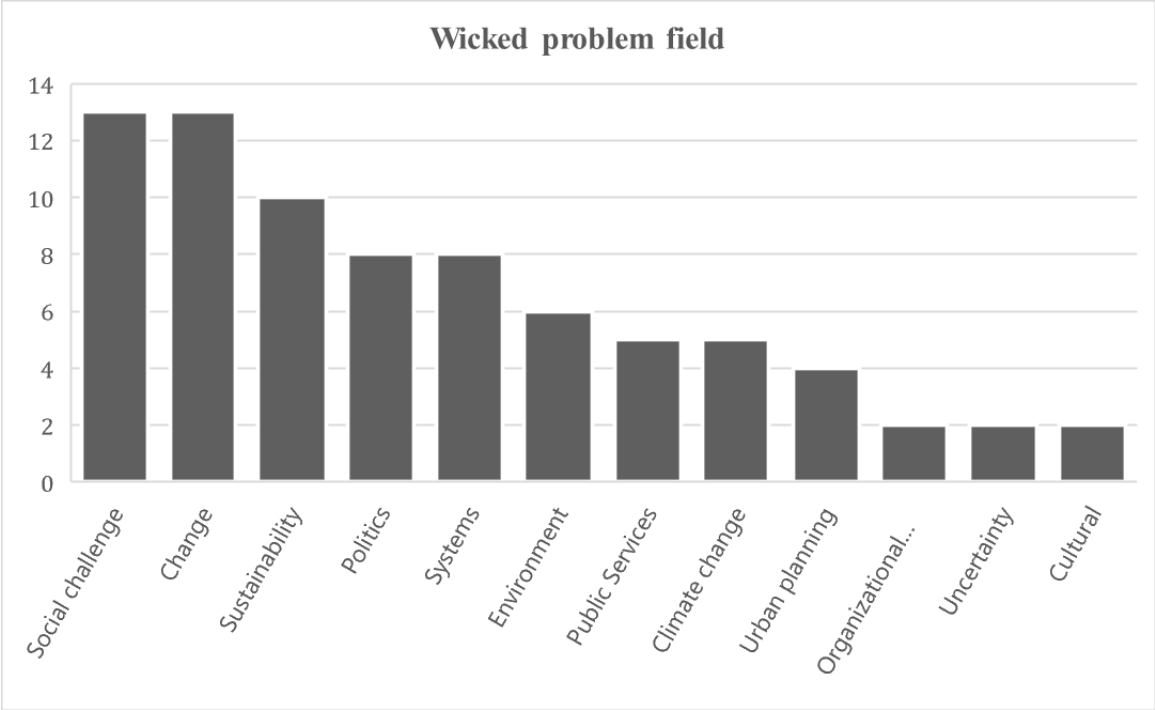

Figure 2 Wicked problem fields the articles mentioned.

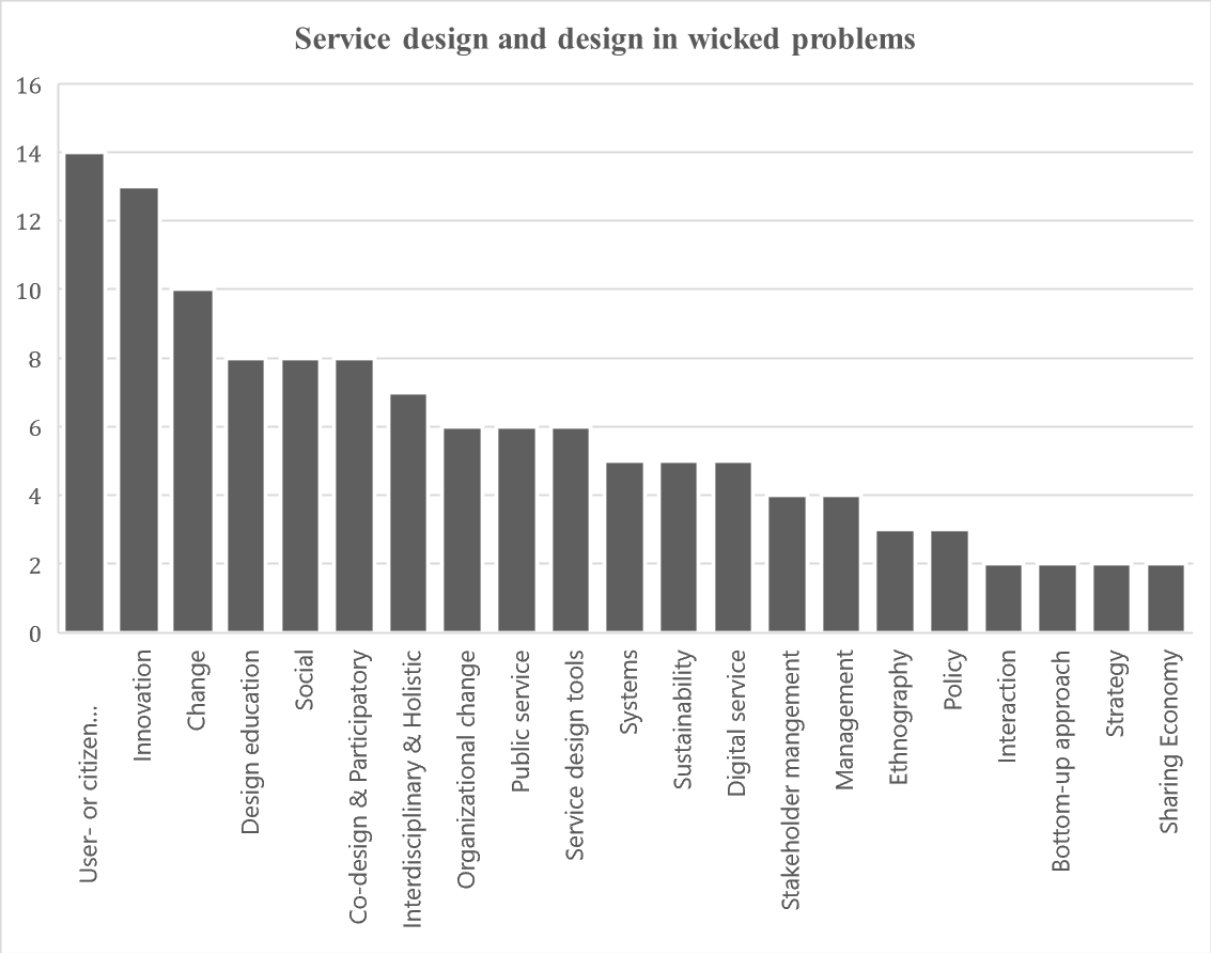

Figure 3 Words coded from the wicked problems in service design and design field.

Figure 3 shows the words that came out from the coding process for defining service design (or design) in the wicked problem context. Interestingly, as the articles broached the topic, it seemed that service design connected with the wicked problem in question as if it were there to make change to it and adopt the user- or citizen-centric approach. Innovation and change seem to go pretty much hand-in-hand and innovation gained high scores. Participatory or co-design approaches are essential in the development of wicked problems. The interdisciplinary and holistic views appeared often and they are strongly related with participatory and co-design approaches. Service design also regards "social" and this correlates much with the earlier chart from the wicked problems field, since service design works with public services, sustainability,

stakeholder management, organizational design and systems. Moreover, service design tools came up because they seem to bring valid insights to the process of tackling wicked problems, especially from the user's perspective; as pointed out by Dixon and Murphy (2016), the skills of visualization are a way of making intangible things tangible. Interestingly, design education from a service design perspective was raised several times. Thus, there is a need to better equip students and design professionals to manage wicked issues in service design. Penin, Staszowski and Brown (2015) point out how design pedagogy requires a transdisciplinary educational approach, integrating fields of knowledge (e.g., management studies and anthropology). Willis (2015) also highlighted philosophy, social and political theory as other important fields of study.

From the coding of wicked problems and service design, a number of similar words can be found and Figure 4 has them grouped with the number of the codes that each field gained. Change and social aspects are paramount issues and right after them come sustainability, politics, systems, public services and organizational change. The issues that service design means to tackle are often wicked. Furthermore, the service design interdisciplinary mindset and the tools could have an important role.

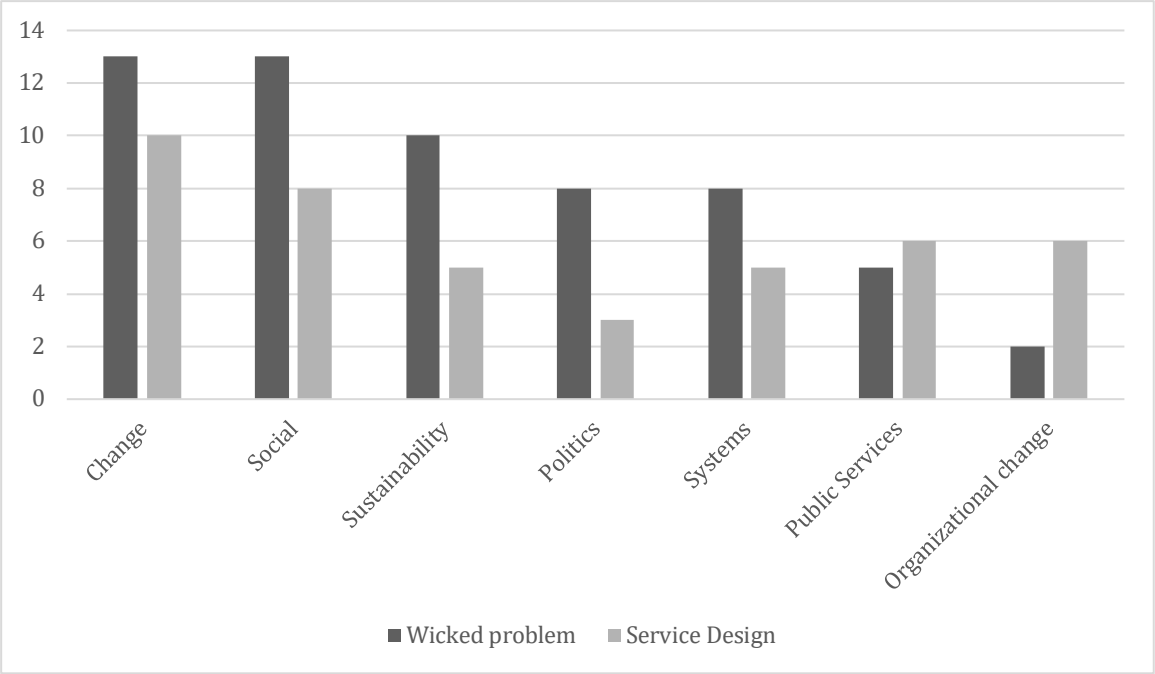

Figure 4 Codes and their frequency with the same titles between wicked problem and service design compared.

It was challenging to see how the articles would separately treat service design connection and role once they are quite intertwined with the whole design context and treated along with social design, transition design etc. The results here cannot thus be seen strictly as service design but as service design and design discipline. As Dixon and Murphy wrote (2017, 59), among many other authors, the role is in change and "strict delineation of sharp professional boundaries is no longer possible". Some even ended the paper asking what their exact role is (Schanz, De Lille 2018). We see that the role is connected with the abilities of service design or design itself has, as depicted in Figure 2. We tried to make coding separately from the articles related to role, but eventually saw that we would be coding much of the same texts as previously from the service design field. We could inductively deduce that service designers or designer's role is to be agents of change by bringing transitions and innovations to the wicked problem field that treat, for example, public services and create sustainability. Service designers use the

bottom-up approach to be facilitators and mediators in the process (e.g. Prendiville 2018; Sepers 2017). The work and the role are to manage complex stakeholder settings through interdisciplinary and holistic approaches (e.g. Tonkinwise 2015; Schanz and De Lille 2018). This makes sense in the light of wicked problems since they are, also, so multifaceted or holistic. We need to bear in mind how the results are limited to the articles selected and that their interpretation is qualitative.

Analysis and Findings

This section concentrates on analysing the whole article together with the theoretical literature on the typology of problems and the systematic literature review. Analysing the literature on the typology of problems according to Heifetz (1994), Roberts (2000), and Head and Alford (2008), we suggest a clearer distinction among simple, complex and wicked problems, as illustrated in Table 1. This distinction is also necessary because the tools differ according to the approach selected. Grey areas can even exist, which will hamper the determination of whether a problem is undoubtedly complex or wicked. Mirroring the tools against the ten points of Rittel and Webber's (1973) wicked problem definition, however, will help us to understand what kind of problem is at stake. Knowing what the problem is will permit the selection of the correct tools and strategies. Translating into practice, "How to design an envelope?" is a simple micro level problem and can be solved, but it could be also treated from a macro level perspective as "How to design an envelope that is sustainable and reduces the effect of global warming?".

Thus, we propose the "Iceberg Model of Design Problems" to illustrate a perspective on the three levels of problems in the form of an iceberg, Figure 5. As Boylston (2019, 164) explains, the iceberg concept comes from the work by the psychoanalyst Sigmund Freud on the unconscious and subconscious mind that remain under the surface, and 'system thinkers use the

metaphor of an iceberg to illustrate how to begin addressing the deeper causes of social problems symptoms'.

The concept of the wicked problem iceberg introduced in an extensive literature review by Monat and Gannon (2015) related to systems thinking is reinforced by Norman and Stappers (2015) in the design field. The idea behind the concept is that designers often seek simple approaches and tools for complex and wicked problems and end up running into an iceberg. Usually, designers only focus on the visible part of the issue without realizing that there is another 'world' beneath; they express 'symptoms of underlying difficulties' (Norman and Stappers 2015, 91) or do not realise that designing can be social practice-oriented (Tonkinwise 2015) and about transformational societal change (Irwin, Kossoff and Tonkinwise 2015).

Our proposed model is made to understand the typologies of design problems and this model should not be confused with most "Iceberg Models" in the field of organizational studies or culture. There is a similarity in that the organizational culture could be at the bottom of the iceberg like it is in the "Iceberg Model", although here we see the wicked problem as a phenomenon that is not necessarily related to just an organization. We see a better resonation with the iceberg model from systems thinking described by Boylston (2019). He wrote about four "layers of depth that capability designers must be mindful of" (Boylston, 2019, 167). The deepest layer of the iceberg are the mental models (underpinned by values or interests also understood as worldviews and paradigms - similar to Head and Alford's diversity aspect) that will influence the underlying structures, patterns and events. Events are at the top of the iceberg, visible at the sea level, and three other layers are below the surface. It is easy to think of fast solutions to these events without realizing the layers below. Nonetheless, these "bandaid" solutions could aggravate the problem if the layers beneath are not treated together.

Also, Eneroth, Hellsten and Hamilton (2009) wrote about how the mental models and culture below the surface are like strong streams, where strategies made only for the top part of the

mountain will not reach below the surface. Hence, collaboration and dialogue are important in the process. In the service design field, we see that the need for more collaboration, time and resources grows as the lower levels of the iceberg are reached. We did not wish to display an exact point of area of the Buchanan's orders on the left-hand side of the iceberg, but illustrate them more as regions.

We suggest that each problem typology should be treated with tools designed for the specific situation, as a paper boat to reach simple problems and a submarine for wicked problems (Fig. 3). The iceberg metaphor makes it visual that when dealing with simple problems, the designer can usually "see" and "understand" the context. Moreover, it is easy "to reach" the "ice mountain" (the problem itself) using the proper tools. Usually, such tools are simple and more operational, which leads to the fact that even an untrained person can understand and solve a problem. However, wicked problems, such as icebergs, have hidden parts. Much of its form and context remains unseen until the designer (or a trained professional) deeply dives into the problem or reaches its hidden parts using specific tools and strategic thinking. The arrows in Figure 5 are made to illustrate the dynamics among the categories as we see that they are not black and white. This model aims to help designers in general to have a more conscious approach to the practice, and reflect how to address each problem category differently. Understanding which type of problem is being handled also contributes to set a more precise schedule and team to deal with it.

We recognise, however, that future studies are required to further explain the tools, methods, and approaches that fit each category. Now we see that for the tame problems, tools as design probes could be used to understand individual or needs of a certain group. Then the second complexity level could be aided by service design tools, such as blueprints and customer's journeys that look at the problem more holistically and at the complexity behind it. The third level should be treated strategically with tools designed for this specific purpose. Norman and Stappers criticize how many of the "existing design methods were developed for relatively simple situations" (p. 91). Thus, a question arises: are the service design tools able to create macro level, wicked problem systemic change?

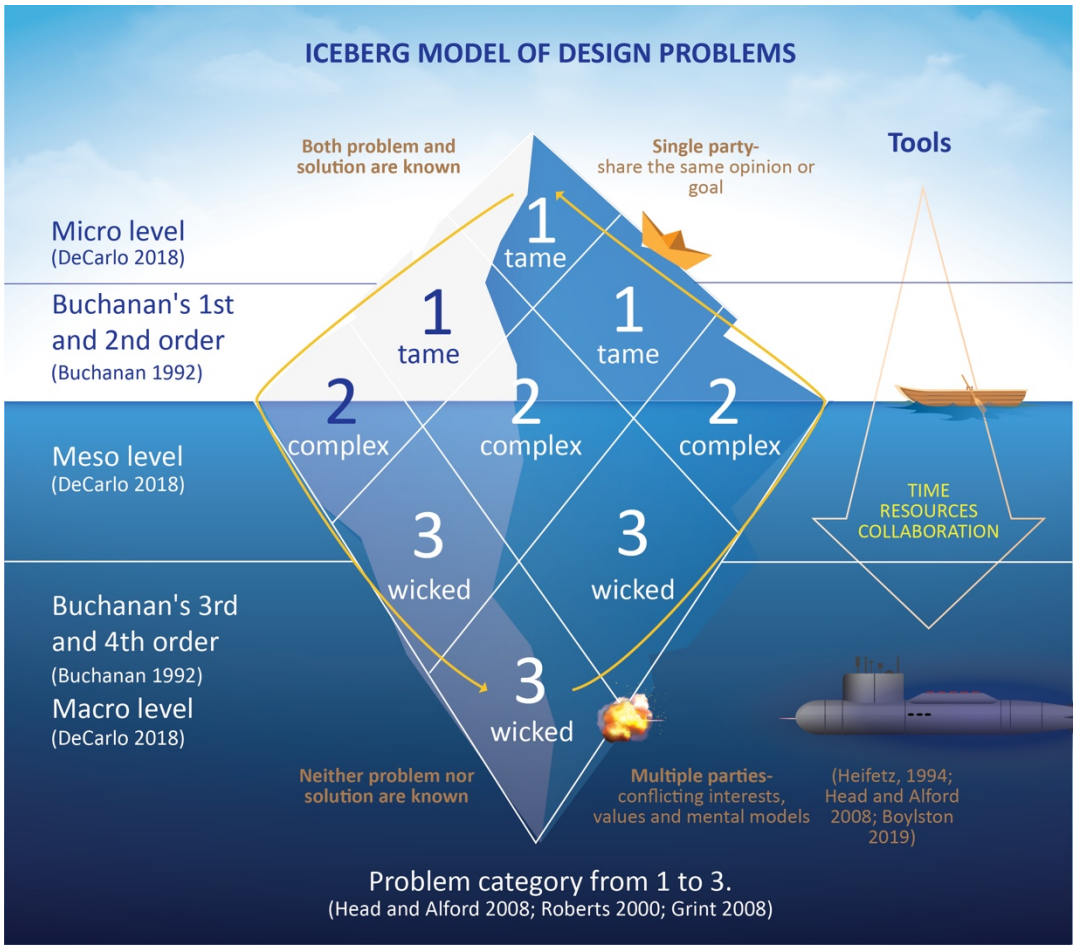

Figure 5 "Iceberg Model of Design Problems"

The systematic literature review of this article suggests that the holistic service design approach and its tools to collaborate and co-design with the stakeholders seems to be suitable to the wicked problem context. A study made by Author (2016, 2019) shows how tools that have been designed solely to treat wicked problems are all collaborative at some level. Wicked problems are an opportunity to utilise complex stakeholder management while basic service design principles bring the right stakeholders to processes by sharing holistic views and working collaboratively (Stickdorn and Schneider 2011; Suoheimo 2016; 2019), which underpins the essence of coping with wicked issues. Moreover, the need for new tools and strategies pointed out by Sangiorgi (2009) and (2011) remains without a proper answer. Bofylatos and Spyrou (2016) claim that there are no tools or strategies to wicked problems. However, could this be

that service designers and the design field itself are not yet that familiar with the wicked problem tools and strategies? In fact, Rittel and Webber (1973) do not mention any tools or strategies. However, authors, such as Horn and Weber (2007), Ritchey (2006) and Williams (2017), present them. It seems that wicked problems are not in the centre of the service design theory, although they should be once they relate to these problems by operating in the same realms as the social, organisational and change fields, among others. Thus, from the literature review, we can summarise wicked problems in connection to service design as follows in Table 3.

Table 3 Summary of the main findings

Findings	**References as some examples**
Service designers **aid in creating innovations** to tackle wicked problems	Schanz and De Lille 2018; Irwin, Kossoff and Tonkinwise 2015
The service designers' or designer's role is to be a **facilitator or mediator** of the process of **collaboration, participatory design and co-design**	Prendiville 2018; Sepers 2017; White and Koten, 2016; Junginger 2017; Westerlund and Wetter-Edman, 2017; Souleles 2017; Bofylatos and Spyrou, 2016
Service design or designers are **agents of change** or facilitators in **transdisciplinary, interdisciplinary or holistic group work**	Tonkinwise 2015; Augsten and Gekeler 2017; Parente and Sedini 2017; Engeler 2017;
Service design is **present in many other fields,** e.g. has importance in **social design, political design**, **management**, **organisational design** and **sustainability.**	Irwin, Kossoff and Tonkinwise 2015; White and Koten 2016; Penin, Staszowsk and Brown 2016; Bofylatos and Spyrou, 2016; Schanz and De Lille 2018
Service design and wicked problems can treat political level problems	Parente and Sedini, 2017; Bofylatos and Spyrou, 2016
Designers use **visualisation skills** to create shared understanding.	Jones and Bowes 2017; Parente and Sedini 2017

There is a need to **better train service designers** in the scope of wicked problems.	Augsten and Gekeler, 2017
There is a need to focus the design on the **environment and not only on the user.**	Evans 2013

Conclusions

This article investigated the connection and role of service design and wicked problems aiming to raise further discussion to clarify what kind of problems designers, especially service designers, deal with their professional practice and to avoid an oversimplification of wicked problems. The systematic literature review seemed to have found a research gap. We can say that although the connection exists, it is little explored in the literature. Also, there seems to exist a lack of deep knowledge about wicked problems theories in the design field; at the same time, articles focusing on design and service education development demanded new approaches to design education in general focusing on service design.

The theories of wicked problems enrich the current service design dialogue and suggest resolutions for socially defined service design problems. Sustainable change and innovations help to tackle those problems. Designers' role in it is to be facilitators or mediators of the process by complex stakeholder management, which requires interdisciplinary and holistic approaches. The fundamental nature of service design is in the co-creation and participatory methods and it is essential that the holistic view is applied as well as bringing the user or community to the centre of the problem. Innovations are needed in the process of handling wicked problems. Service design in wicked problems is also related to social-, political-, management-, organizational design and sustainability, since the overall aim is to create changes in all these areas.

A clear idea of the problem category, but also the understanding that such a category is related to the other levels of problems, as illustrated by the "Iceberg Model of Design Problems", help the multi-shaped design teams to use the "suitable" tools and approach (note that even "right" tools will bring "clumsy solutions") and strategies in solving wicked or complex problems. We claim it is vital to have a strategic level approach to tackle wicked problems. Thus, wicked problems would not be treated too simplistically, aggravating the problem at hand. Our research also argues that complex and wicked problems should be kept as two different problem fields although the distinction is not always clear. Different methodologies and methods apply to these problem categories. We see that service design and other design fields related to wicked problems would benefit from the proposed model since there is a demanding need for the service design field to better address wicked problems more suitably. The lack of understanding of organizational studies, theory or systems and wicked problems, as some examples, can hinder a service designer to treat wicked issues appropriately.

Moreover, we suggest further studies focusing on tools and methods that could better fit to each part of the "Iceberg Model of Design Problems" since this article did not focus specifically on them. Future research is also needed to clarify whether there is a need for new strategies and tools or only for adapting existing ones for wicked problems in service design. Although this systematic literature review did not concentrate on systems thinking, the concept appeared in some articles reviewed. Thus, we recognise these research limit and recommend future studies on wicked problems, service design and systems thinking. The same research would also be interesting to other fields that treat greater complexities, such as sociotechnical systems.

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